

Form PTO-449  
(REV. 8-88)U.S. DEPARTMENT OF COMMERCE  
PATENT AND TRADEMARK OFFICE

ATTY. DOCKET NO.

015685.P019C

SERIAL NO.

09/689,228

## INFORMATION DISCLOSURE CITATION

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APPLICANT

Craig H. Barratt

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## U.S. PATENT DOCUMENTS

| *EXAMINER<br>INITIAL | DOCUMENT NUMBER | DATE     | NAME            | CLASS | SUBCLASS | FILING DATE<br>IF APPROPRIATE |
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| B                    | 3,704,465       | 11/28/72 | Masak et al.    | —     | —        |                               |
| B                    | 3,774,209       | 11/20/73 | Fleming et al.  | —     | —        |                               |
|                      | 3,798,645       | 03/19/74 | Baurle et al.   | —     | —        |                               |
|                      | 3,852,749       | 12/03/74 | Kohler          | —     | —        |                               |
|                      | 3,946,385       | 03/23/76 | Ewen            | —     | —        |                               |
|                      | 4,005,379       | 01/25/77 | Lerner          | —     | —        |                               |
|                      | 4,035,746       | 07/12/77 | Covington Jr.   | —     | —        |                               |
|                      | 4,085,319       | 04/18/78 | Deitz et al.    | —     | —        |                               |
|                      | 4,128,740       | 12/05/78 | Graziano        | —     | —        |                               |
|                      | 4,263,568       | 04/21/81 | Nemit           | —     | —        |                               |
|                      | 4,316,191       | 02/16/82 | Sawatari et al. | —     | —        |                               |

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|                 |          |                |       |          | YES         | NO |
| B 2 237 706 A   | 5/8/91   | United Kingdom | —     | —        |             |    |
| B 2 295 524 A   | 5/29/96  | United Kingdom | —     | —        |             |    |
| B 2 313 261 A   | 11/19/97 | United Kingdom | —     | —        |             |    |

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| B | Acampora et al., "A New Adaptive MAC Layer Protocol for Wireless ATM Networks in Harsh Fading and Interference Environments", 1997 IEEE, pp. 410-415.                                   |
| B | Agee, "Blind Separation and Capture of Communication Signals Using A Multitarget Constant Modulus Beamformer", 10/7/89 Proc. IEEE Military Communications Conference, Vol. 2, pp. 1-12. |
| B | Aschied et al., "An All Digital Receiver Architecture for Bandwidth Efficient Transmission at High Data Rates", 1989, IEEE Transactions on Communications, Vol. 37, No. 8, pp. 804-813. |

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| B                    | 4,375,622       | 03/01/83 | Hollingsworth et al. | —     | —        |                               |
| B                    | 4,434,505       | 02/28/84 | Gutleber             | —     | —        |                               |
| B                    | 4,475,010       | 10/02/84 | Huensch et al.       | —     | —        |                               |
|                      | 4,626,859       | 12/02/86 | Stansfield           | —     | —        |                               |
|                      | 4,639,732       | 01/27/87 | Acoraci et al.       | —     | —        |                               |
|                      | 4,639,914       | 01/27/87 | Winters              | —     | —        |                               |
|                      | 4,658,096       | 04/14/87 | West, Jr. et al.     | —     | —        |                               |
|                      | 4,737,794       | 04/12/88 | Jones                | —     | —        |                               |
|                      | 4,737,975       | 04/12/88 | Shafer               | —     | —        |                               |
|                      | 4,742,356       | 05/03/88 | Kuipers              | —     | —        |                               |
|                      | 4,750,147       | 06/07/88 | Roy, III et al.      | —     | —        |                               |

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|-----------------|---------|---------|-------|----------|-------------|----|
|                 |         |         |       |          | YES         | NO |
| B 0 639 035 A1  | 2/15/95 | EPO     | —     | —        |             |    |
| B 0 713 261 A1  | 5/22/96 | EPO     | —     | —        |             |    |
| B 0 777 400 A2  | 6/4/97  | EPO     | —     | —        |             |    |

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| B | Franks, "Synchronization Subsystems: Analysis and Design", 1981, Digital Communications Satellite/Earth Station Engineering, pp. 294-335.                          |
| B | Friedlander, "Direction Finding Using an Interpolated Array", 4/3/90, International Conference on Acoustics, Speech, and Signal Processing, Vol. 5, pp. 2951-2954. |
| B | Friedlander et al., "Direction Finding for Wideband Signals Using an Interpolated Array", 1991, IEEE Publication, pp. 583-587.                                     |

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|---------------------|-----------------|----------|------------------|-------|----------|-------------------------------|
| <i>B</i>            | 4,775,997       | 10/04/88 | West Jr. et al.  | 1     | 1        |                               |
| <i>B</i>            | 4,796,291       | 01/03/89 | Makino           | 1     | 1        |                               |
| <i>B</i>            | 4,827,395       | 05/02/89 | Anders et al.    | 1     | 1        |                               |
|                     | 4,829,554       | 05/09/89 | Barnes et al.    | 1     | 1        |                               |
|                     | 4,837,800       | 06/06/89 | Freeburg et al.  | 1     | 1        |                               |
|                     | 4,855,748       | 08/08/89 | Brandao et al.   | 1     | 1        |                               |
|                     | 4,910,794       | 03/20/90 | Mahany           | 1     | 1        |                               |
|                     | 4,922,517       | 05/01/90 | West, Jr. et al. | 1     | 1        |                               |
|                     | 4,926,186       | 05/15/90 | Kelly et al.     | 1     | 1        |                               |
|                     | 4,940,963       | 07/10/90 | Gutman et al.    | 1     | 1        |                               |
| <i>V</i>            | 4,947,452       | 08/07/90 | Hattori et al.   | 1     | 1        |                               |

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|                   |          |         |       |          | YES         | NO |
| <i>B</i> 95/34103 | 12/14/95 | WO      | 1     | 1        |             |    |
| <i>B</i> 98/01963 | 1/15/98  | WO      | 1     | 1        |             |    |
| <i>B</i> 98/17037 | 4/23/98  | WO      | 1     | 1        |             |    |

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| <i>B</i> | Ganz et al., "A Data-Derived Reference Signal Technique for Adaptive Arrays", IEEE Transactions on Communications, Vol. 37, No. 9, 9/1989, pp. 975-983.                            |
| <i>B</i> | Ittis et al., "A Digital DS Spread-Spectrum Receiver With Joint Channel and Doppler Shift Estimation", IEEE Transactions on Communications, Vol. 39, No. 8, 8/1991, pp. 1255-1267. |
| <i>B</i> | Krishnamurthy et al., "Polling Based Media Access Protocols For Use With Smart Adaptive Array Antennas", 1998 IEEE, pp. 337-344.   |

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|----------------------|-----------------|----------|------------------|-------|----------|-------------------------------|
| <i>B</i>             | 4,955,082       | 09/04/90 | Hattori et al.   | ✓     | —        |                               |
| <i>B</i>             | 4,965,732       | 10/23/90 | Roy, III et al.  | ✓     | —        |                               |
| <i>B</i>             | 4,965,849       | 10/23/90 | Kunihiro         | ✓     | —        |                               |
|                      | 4,965,850       | 10/23/90 | Schloemer        | ✓     | —        |                               |
|                      | 4,972,151       | 11/20/90 | Rosen            | ✓     | —        |                               |
|                      | 4,989,204       | 01/29/91 | Shimizu et al.   | ✓     | —        |                               |
|                      | 5,041,833       | 08/20/91 | Weinberg         | ✓     | —        |                               |
|                      | 5,052,799       | 10/01/91 | Sasser et al.    | —     | ✓        |                               |
|                      | 5,093,924       | 03/03/92 | Toshiyuki et al. | —     | —        |                               |
|                      | 5,103,459       | 04/07/92 | Gilhousen et al. | —     | —        |                               |
|                      | 5,109,535       | 04/28/92 | Kume et al.      | —     | —        |                               |

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|-------------------|---------|---------|-------|----------|-----------------------|
| <i>B</i> 98/17071 | 4/23/98 | WO      | ✓     | —        |                       |
| <i>B</i> 98/28864 | 7/2/98  | WO      | ✓     | —        |                       |
| <i>B</i> 98/33346 | 7/30/98 | WO      | ✓     | —        |                       |

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| <i>B</i> | Lee et al., "Decision Directed Carrier Recovery - Chapter 16: Carrier Recovery", 1994 Digital Communications, 2nd Edition, Kluwer Academic Pub., pp. 725-736.  |
| <i>B</i> | Lee et al., "Decision Directed Carrier Recovery - Chapter 17: Timing Recovery", 1994 Digital Communications, 2nd Edition, Kluwer Academic Pub., pp. 737-764.   |
| <i>B</i> | Lundell et al., "Applications of the Constant Modulus Adaptive Beamformer to Constant and Non-Constant Modulus Signals", Proceedings, 1998 Asilomar Conference on Signals, Svstems. and Computers (ACSSC-1988). pp. 432-436. |

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|----------------------|-----------------|----------|-------------------|-------|----------|-------------------------------|
| B                    | 5,124,697       | 06/23/92 | Moore             | ✓     | ✓        |                               |
| B                    | 5,142,253       | 08/25/92 | Mallavarpu et al. | ✓     | ✓        |                               |
| B                    | 5,159,593       | 10/27/92 | D'Amico et al.    | ✓     | ✓        |                               |
|                      | 5,255,210       | 10/19/93 | Gardner et al.    | ✓     | ✓        |                               |
|                      | 5,260,968       | 11/09/93 | Gardner et al.    | ✓     | ✓        |                               |
|                      | 5,262,789       | 11/16/93 | Silverstein       | ✓     | ✓        |                               |
|                      | 5,274,844       | 12/28/93 | Harrison et al.   | ✓     | ✓        |                               |
|                      | 5,283,540       | 02/01/94 | Myer              | ✓     | ✓        |                               |
|                      | 5,299,148       | 03/29/94 | Gardner et al.    | ✓     | ✓        |                               |
|                      | 5,335,249       | 08/02/94 | Krueger et al.    | ✓     | ✓        |                               |
|                      | 5,345,596       | 09/06/94 | Buchenhorn et al. | ✓     | ✓        |                               |

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|                 |        |         |       |          | YES         | NO |
| 7-170548        | 4/7/95 | Japan   | ✓     | ✓        |             | X  |
|                 |        |         | ✓     | ✓        |             |    |
|                 |        |         | ✓     | ✓        |             |    |

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| B | Muhamed et al., "Direction of Arrival Estimation Using Antenna Arrays", 1996, The Bradley Dept. of Electrical Engineering, Mobile and Portable Radio Research Group, Section 3.8, pp. 64-71.   |
| B | vander Veen et al., "A Constant Modulus Factorization Technique for Smart Antenna Applications in Mobile Communications", SPIE 1994 "Advanced Signal Processing Algorithms, Architectures, and Implementations V", Vol. 2296, pp. 230-241. |
| B | Talwar et al., "Recursive Algorithms for Estimating Multiple Co-Channel Digital Signals Received at an Antenna Array", Proc. Fifth Annual IEEE Dual Use Technologies and Applications Conference.  |

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| <i>[Signature]</i>   | 5,361,303       | 11/01/94 | Eatwell            | —     | —        |                               |
| <i>[Signature]</i>   | 5,367,559       | 11/22/94 | Kay et al.         | —     | —        |                               |
| <i>[Signature]</i>   | 5,379,320       | 01/03/95 | Fernandes et al.   | —     | —        |                               |
| <i>[Signature]</i>   | 5,387,915       | 02/07/95 | Moussa et al.      | —     | —        |                               |
| <i>[Signature]</i>   | 5,423,072       | 06/06/95 | Iwashita et al.    | —     | —        |                               |
| <i>[Signature]</i>   | 5,430,760       | 07/04/95 | Dent               | —     | —        |                               |
| <i>[Signature]</i>   | 5,440,281       | 08/08/95 | Wey et al.         | —     | —        |                               |
| <i>[Signature]</i>   | 5,448,621       | 09/05/95 | Knudsen            | —     | —        |                               |
| <i>[Signature]</i>   | 5,457,812       | 10/10/95 | Siira et al.       | —     | —        |                               |
| <i>[Signature]</i>   | 5,465,399       | 11/07/95 | Oberholtzer et al. | —     | —        |                               |
| <i>[Signature]</i>   | 5,471,647       | 11/28/95 | Gerlach et al.     | —     | —        |                               |

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|                 |      |         |       |          | YES NO      |
|                 |      |         |       |          |             |
|                 |      |         |       |          |             |

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| <i>[Signature]</i> | Papadias et al., "A Space-Time Constant Modulus Algorithm for SDMA Systems", 1996, Proceedings, IEEE 46th Vehicular Technology Conference, pp. 86-90.  |
| <i>[Signature]</i> | Talwar et al., "Blind Estimation of Multiple Co-Channel Digital Signals Arriving at an Antenna Array", 1993, Proc. 27th Asilomar Conference on Signals, Systems, and Computers, Vol. 1, pp. 349-342. |
| <i>[Signature]</i> | Rashid-Farrokhi et al., "Joint Power Control and Beamforming for Capacity Improvement in Wireless Networks With Antenna Array", 1996 IEEE GLOBECOM 1996, Vol. 1, pp. 555-559.                        |

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| <i>[Signature]</i>   | 5,475,864       | 12/12/95 | Hamabe             | ✓     | ✓        |                               |
| <i>[Signature]</i>   | 5,475,868       | 12/12/95 | Duque-Anton et al. | ✓     | ✓        |                               |
| <i>[Signature]</i>   | 5,497,505       | 03/05/96 | Koohgoli et al.    | ✓     | ✓        |                               |
| <i>[Signature]</i>   | 5,515,378       | 05/07/96 | Roy, III et al.    | ✓     | ✓        |                               |
| <i>[Signature]</i>   | 5,530,449       | 06/25/96 | Wachs et al.       | ✓     | ✓        |                               |
| <i>[Signature]</i>   | 5,530,917       | 06/25/96 | Andersson et al.   | ✓     | ✓        |                               |
| <i>[Signature]</i>   | 5,532,706       | 07/02/96 | Reinhardt et al.   | ✓     | ✓        |                               |
| <i>[Signature]</i>   | 5,537,438       | 06/16/96 | Mourot et al.      | ✓     | ✓        |                               |
| <i>[Signature]</i>   | 5,543,801       | 08/06/96 | Shawyer            | ✓     | ✓        |                               |
| <i>[Signature]</i>   | 5,546,090       | 08/13/96 | Roy, III et al.    | ✓     | ✓        |                               |
| <i>[Signature]</i>   | 5,548,813       | 08/20/96 | Charas et al.      | ✓     | ✓        |                               |

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|                 |      |         |       |          |             |    |
|                 |      |         |       |          |             |    |

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|--------------------|--|
| <i>[Signature]</i> | Rashid-Farrokhi et al., "Transmit Beamforming for Cellular Communication Systems", Conference on Information Sciences and Systems, CISS-97; 3/1997, 4 pages.                                     |
| <i>[Signature]</i> | Rashid-Farrokhi et al., "Downlink and Uplink Capacity Enhancement in Power Controlled Cellular Systems", Proceedings, 1997 IEEE 47th Vehicular Technology Conference, Vol. 2, 5/97, pp. 647-651. |
| <i>[Signature]</i> | Rashid-Farrokhi et al., "Downlink Power Control and Base Station Assignment", IEEE Communications Letters, Vol. 1, No.4, 07/97, pp. 102-104.   |

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| <i>[Signature]</i>   | 5,553,074       | 09/03/96 | Acampora       | —     | —        |                               |
| <i>[Signature]</i>   | 5,555,445       | 09/10/96 | Booth          | —     | —        |                               |
| <i>[Signature]</i>   | 5,557,657       | 09/17/96 | Barnett        | —     | —        |                               |
| <i>[Signature]</i>   | 5,565,873       | 10/15/96 | Dean           | —     | —        |                               |
| <i>[Signature]</i>   | 5,566,209       | 10/15/96 | Forssen et al. | —     | —        |                               |
| <i>[Signature]</i>   | 5,576,717       | 11/19/96 | Searle et al.  | —     | —        |                               |
| <i>[Signature]</i>   | 5,592,490       | 01/07/97 | Barratt et al. | —     | —        |                               |
| <i>[Signature]</i>   | 5,596,625       | 01/21/97 | LeBlanc        | —     | —        |                               |
| <i>[Signature]</i>   | 5,603,082       | 02/11/97 | Hamabe         | —     | —        |                               |
| <i>[Signature]</i>   | 5,603,089       | 02/11/97 | Searle et al.  | —     | —        |                               |
| <i>[Signature]</i>   | 5,606,729       | 02/25/97 | D'Amico et al. | —     | —        |                               |

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|                 |      |         |       |          |             |    |
|                 |      |         |       |          |             |    |

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| <i>[Signature]</i> | Xu et al., "Throughput Multiplication of Wireless LANs for Multimedia Services: SDMA Protocol Design", 1994, IEEE, pp. 1326-1332.  |
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## U.S. PATENT DOCUMENTS

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| <i>[Signature]</i>   | 5,615,409       | 03/25/97 | Forssen et al.  | /     | /        |                               |
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| <i>[Signature]</i>   | 5,625,885       | 04/29/97 | Nakazawa et al. | /     | /        |                               |
| <i>[Signature]</i>   | 5,638,375       | 06/10/97 | Dettro et al.   | /     | /        |                               |
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| <i>[Signature]</i>   | 5,673,291       | 09/30/97 | Dent            | /     | /        |                               |
| <i>[Signature]</i>   | 5,675,581       | 10/7/97  | Soliman         | /     | /        |                               |
| <i>[Signature]</i>   | 5,678,188       | 10/14/97 | Hisamura        | /     | /        |                               |
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| <i>[Signature]</i> | Zhang et al., "Performance of a Modified Polling Strategy for Broadband Wireless LANs in a Harsh Fading Environment", 1991, GLOBECOM 1991, pp. 1141-1146. |
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| <i>Be</i>            | 5,697,066       | 12/09/97 | Acampora          | —     | —        |                               |
| <i>Be</i>            | 5,726,978       | 03/10/98 | Frodigh et al.    | ✓     | ✓        |                               |
|                      | 5,732,076       | 03/24/98 | Ketseoglou et al. | ✓     | ✓        |                               |
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| <i>[Signature]</i>   | 5,818,918       | 10/06/98 | Fujii             | —     | —        |                               |
| <i>[Signature]</i>   | 5,819,182       | 10/06/98 | Gardner et al.    | —     | —        |                               |
| <i>[Signature]</i>   | 5,825,762       | 10/20/98 | Kamin, Jr. et al. | —     | —        |                               |
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| <i>[Signature]</i>   | 5,884,148       | 03/16/99 | Bilgic et al.     | —     | —        |                               |
| <i>[Signature]</i>   | 5,887,038       | 03/23/99 | Golden            | —     | —        |                               |
| <i>[Signature]</i>   | 5,905,721       | 05/18/99 | Liu et al.        | —     | —        |                               |
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|----------------------|-----------------|----------|-----------------|-------|----------|-------------------------------|
| <i>TS</i>            | 5,930,243       | 07/27/99 | Parish et al.   | ✓     | ✓        |                               |
| <i>TS</i>            | 5,933,421       | 08/03/99 | Alamouti et al. | ✓     | ✓        |                               |
| <i>TS</i>            | 5,955,992       | 09/21/99 | Shattil         | ✓     | ✓        |                               |
|                      | 5,970,394       | 10/19/99 | Arpee et al.    | ✓     | ✓        |                               |
|                      | 5,973,638       | 10/26/99 | Robbins et al.  | ✓     | ✓        |                               |
|                      | 5,999,826       | 12/07/99 | Whinnett        | ✓     | ✓        |                               |
|                      | 6,005,854       | 12/21/99 | Xu et al.       | ✓     | ✓        |                               |
|                      | 6,009,124       | 12/28/99 | Smith et al.    | ✓     | ✓        |                               |
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|                      | 6,018,555       | 01/25/00 | Mahany          | ✓     | ✓        |                               |
|                      | 6,018,643       | 01/25/00 | Golemon et al.  | ✓     | ✓        |                               |

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| <i>[Signature]</i>   | 6,023,203       | 02/08/00 | Parish             | —     | —        |                               |
| <i>[Signature]</i>   | 6,061,553       | 05/09/00 | Matsuoka et al.    | —     | —        |                               |
| <i>[Signature]</i>   | 6,064,865       | 05/16/00 | Kuo et al.         | —     | —        |                               |
| <i>[Signature]</i>   | 6,067,324       | 05/23/00 | Harrison           | —     | —        |                               |
| <i>[Signature]</i>   | 6,108,565       | 08/22/00 | Scherzer           | —     | —        |                               |
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| <i>[Signature]</i>   | 6,154,661       | 11/28/00 | Goldburg           | —     | —        |                               |
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| Application Number     | 09/689,228       |
| Filing Date            | October 11, 2000 |
| First Named Inventor   | Craig Barratt    |
| Group Art Unit         | 2683             |
| Examiner Name          | T. Gessese       |
| Attorney Docket Number | 15685P019C       |

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